

**SUICIDE ATTEMPTS BY ACTIVE DUTY MILITARY PERSONNEL: FINDINGS FROM  
THE 2015 DEPARTMENT OF DEFENSE HEALTH-RELATED BEHAVIORS SURVEY**

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## **Abstract**

In the last decade, the suicide rate among the active-duty U.S. military has increased significantly, almost doubling in the Army and Marines Corps. The prevalent view is that factors related to military deployments are the primary drivers associated with risk of suicide, but the research evidence is mixed. There are factors, not directly related to deployment, associated with risk of suicide that is common in many studies such as suicide attempts, substance abuse problems, and young age. This study examines the extent to which suicide attempts are associated with Posttraumatic Stress Disorder (PTSD) or depression among active duty military personnel using binomial logistic regression. The regression model uses data from the 2015 Department of Defense Health-Related Behaviors Survey, which provides physical and mental health information on 16,699 active duty personnel in all branches of the U.S. military. This analysis finds that service members with probable PTSD or depression have a high likelihood of attempting suicide controlling for common suicide factors. Understanding the predictors of suicide attempts will inform approaches to mitigate suicide risk in the U.S military.

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# 1 Introduction

The U.S. military has usually experienced lower suicide rates compared with the general U.S. population. But, in the last decade, the suicide rate among the active-duty U.S. military has increased significantly (Reger et al. 2015). These suicide rates are high enough where suicide has become the leading cause of death for U.S. military service members, claiming more lives than combat and transportation accidents (VanSickle et al. 2016).

Deaths of the service members from suicide are a significant concern for the U.S. military, but there are other associated effects of suicide that are harmful to the military. Recruitment will become difficult from the bad publicity of increasing military suicide rates. Retaining service members will also be a struggle if the perception is staying in the military is associated with a high risk of suicide. As the Department of Defense (DoD) continues to push for increasing military capabilities (i.e., 355 ships Navy fleet), recruiting and retaining service members is crucial to support the growing military force.

The DoD runs 900 suicide prevention programs to combat these rising suicide rates. Despite all these programs, the suicide rates nearly doubled since 2001 so DoD is looking for ways to make these suicide prevention programs more effective and cut the funding for those programs that do not work (Brewin 2013).

Suicides in the military is an important issue not only for those in the military but the family members of the military. They already have to endure the suffering of seeing their loved ones go on months-long deployments to hostile areas. The last thing they also want to worry about is the fear of their loved ones committing suicide. These family members are fully invested in making sure the military takes the necessary actions to prevent these military suicide rates from increasing.

Deaths by suicide remains a rare outcome making it a challenge to study, but studies are being done with the limited data available. Research focuses on identifying and quantifying risk factors associated with suicide in current and former U.S. military personnel due to these high military

suicide rates. The history of previous suicide attempts has been identified as a critical predictor of a future death by suicide, so this study focuses on suicide attempts, which has higher numbers than suicide deaths (Ramchand et al. 2011; Alexander et al. 2014; Yacobi et al. 2013).

The focus of this study is to evaluate how mental health disorders (PTSD and depression) affects the likelihood of a service member to attempt suicide controlling for common suicide factors. Also, this study evaluates which other suicide factors may produce a high probability that a service member attempts suicide.

## **2 Literature Review**

When U.S. military suicide deaths began to increase significantly in 2005, military deployments were assumed to be one of the primary factors associated with the risk of suicide (Leard-Mann et al. 2013). Researchers considered factors related to deployments that include combat exposure, cumulative days deployed and the number of deployments. Factors that were found to heighten suicide risk related to combat exposure from deployments include posttraumatic stress disorder (PTSD) and depression. (Schoenbaum et al. 2014; Harrell and Berglass 2011; Bryan and Cukrowicz 2011; Yacobi et al. 2013). There are specific mental health disorders like schizophrenia which are not a big concern for the U.S. military because these disorders are cause for rejection at enlistment (Ramchand et al. 2011). But, there are mental health disorders like depression that have a greater concern. In 2002, the Institute of Medicine (IOM) estimated that approximately 4 percent of those with depression would die by suicide (Ramchand et al. 2011). Early research concluded that there was an elevated suicide risk among U.S. military who were in deployments (Shelef et al. 2014; Harrell and Berglass 2011; Schoenbaum et al. 2014; Ramchand et al. 2011; Bryan and Cukrowicz 2011; Yacobi et al. 2013).

Many of these studies used the interpersonal-psychological theory of suicide (IPTS) to support their findings. IPTS theorizes that for an individual to attempt suicide, the individual must have

a suicidal desire and a capability for suicide. Suicidal desire has two parts: thwarted belongingness and perceived burdensomeness. According to the IPTS, capability for suicide is obtained by exposure to painful experiences, which leads to lower an individual's fear of death and raises their pain tolerance. Three parts feed into the capability for suicide: past suicidal behaviors, exposure to death and/or severe injury, and past injury and/or abuse (Bryan and Cukrowicz 2011).

The findings of these studies were that military deployment might negatively affect all three IPTS factors. When on deployment, military personnel are away from a familiar environment and have difficulties adjusting to a new environment which may increase thwarted belongingness and feelings of burdensomeness. A capability for suicide may increase from combat exposure from deployments involving violence, aggression, injury, and death.

Contrarily, there are findings from other studies that reveal deployment-related factors were not associated with increased risk of suicide. One study used data from randomly selected samples of all the U.S. military services in 2000, 2003, and 2006 to identify risk factors associated with suicide in current and former U.S. military personnel. The data collected included: demographic, military, mental health, behavioral and deployment characteristics. The findings were that none of the deployment-related factors were associated with increased risk of suicide. Male sex, depression, manic-depressive disorder, heavy drinking, and alcohol-related problems were the factors significantly associated with increased of suicide (LeardMann et al. 2013).

Another study examined the association between suicides and deployment among the service members who served during Operation Enduring Freedom or Operation Iraqi Freedom, including suicides that occurred after separation from the military. The findings were that deployment was not associated with the rate of suicide. Service members who separated the military less than four years of service or those who did not have an honorable discharge were associated with an increased rate of suicide (Reger et al. 2015).

The strength of these studies includes analysis about deployment among active military and those who separated from the U.S. military, also known as veterans (LeardMann et al. 2013; Reger

et al. 2015). In contrast, other studies focused on data for only active U.S. military personnel, a specific military service (e.g., U.S. Army, U.S. Air Force), or another country's military (i.e., Israel Defense Forces) (Shelef et al. 2014; Schoenbaum et al. 2014; Ramchand et al. 2011; Bryan and Cukrowicz 2011; Yacobi et al. 2013).

The studies that did not identify deployment-related factors as associated with risk for suicide had limitations too. One of the studies did not include data from combat exposure and mental health status in their analysis (Reger et al. 2015). Another study used survey data collected in 2000, 2003, and 2006. This data is not only dated, but there was a low response rate in the surveys, which may introduce bias (LeardMann et al. 2013).

There were several factors associated with U.S. military suicides, not explicitly related to deployment, which were common in many of the studies. A strong predictor of future death by suicide has been a history of previous suicide attempts. Even though the majority of past suicide attempts were not lethal, those who had previous suicide attempts is a factor associated with risk of suicide (Ramchand et al. 2011; Alexander et al. 2014; Yacobi et al. 2013). Unfortunately, service members who attempted suicides are likely underreported due to the stigma in the military of someone attempted suicide as weak and selfish. Also, these service members do not seek any help because of this stigma which makes their situations worse (VanSickle et al. 2016). Also, there is evidence of those who attempted suicide were also diagnosed with mental health disorders (Yacobi et al. 2013).

Another common suicide risk factor is if the service member is in the Army or the Marine Corps. The suicide rate almost doubled in the Army and Marines Corps in the past decade (Reger et al. 2015). In 2008, the U.S. Marines and the U.S. Army had the highest rates (19.5 per 100,000 and 18.5 per 100,000, respectively), while the U.S. Air Force and the U.S. Navy had the lowest rates (12.1 per 100,000 and 11.6 per 100,000, respectively) (Ramchand et al. 2011). In 2012, the U.S. Army reported the highest rate at 29.7 per 100,000 and the U.S. Air Force reported the lowest rate at 15.0 per 100,000 (VanSickle et al. 2016).

Issues dealing with relationships, substance abuse, and money have also been shown to be factors associated with increased risk of suicide. Relationship problems include failed intimate and military relationships along with tragic life events like a loss of a family member (Braswell and Kushner 2012; Reger et al. 2015; Alexander et al. 2014; Ramchand et al. 2011). Substance abuse problems were also associated with increased risk of suicide. The risk of suicide varies according to the type of substance (e.g., alcohol, other drugs) being abused (Braswell and Kushner 2012; Ramchand et al. 2011; Alexander et al. 2014; LeardMann et al. 2013). The U.S. military conducts periodic screening for drugs, so drug abuse is not as prevalent as heavy alcohol drinkers. About 20 percent of service members were reported to drink five or more drinks per occasion at least once a week (Ramchand et al. 2011). Financial problems also have been associated with risk of suicide (Ramchand et al. 2011). U.S. military suicides were also associated with the following demographic data: males, white, young, enlisted, and not married (LeardMann et al. 2013; Reger et al. 2015; Schoenbaum et al. 2014; Yacobi et al. 2013; Braswell and Kushner 2012).

Based on this literature review, service members who have a mental health disorder (caused by deployments or other means) will have a higher risk to commit suicide. Therefore, the hypothesis is that service members with PTSD or depression will have a higher likelihood of attempting suicide controlling for common suicide factors.

## **3 Data and Methods**

### **3.1 Dataset Overview**

The dataset used in this report was from the 2015 Health Related Behaviors Survey (HRBS) conducted by the U.S. Department of Defense (DoD) and was administered to U.S. active-duty personnel in the Air Force, Army, Marine Corps, Navy, and Coast Guard who were not deployed as of August 31, 2015. The purpose of the HRBS was to understand the well-being of the U.S.



military service members so issues can be identified that may affect the ability of a service member to meet the demands of military service. This survey includes areas such as mental and physical health along with health-related behaviors like suicide attempts. A total of 1,374,590 service members were in the eligible population. 201,990 military personnel were invited to participate in the survey, but only 16,699 service members fully completed the surveys (Meadows et al. 2005).

The 2015 HRBS Public Use data file was obtained from the Defense Health Agency (DHA) who sponsored the survey. Because this data file was public use only, some data was removed from the original study such as specific demographic data (e.g., race, education, and specific pay grades) and deployment data (e.g., number of deployments, combat exposure).

### **3.2 Variables**

Suicide attempt was the dependent variable used in this analysis. In the HRBS, there were five suicide attempt questions based on when the attempts occurred: during the past 12 months (in relation to when the survey was taken), since joining the military, before joining the military, during the deployment or anytime during their lifetime. The variable associated with the suicide attempts during the past 12 months was used because other variables included in this analysis also focused on the past 12 months. There were only 78 service members who attempted suicide during the past 12 months of when the survey was taken (0.5% of the total dataset).

The independent variables used were split into three groups: Mental Health, Demographic, and Problem.

The Mental Health variables were PTSD and depression. These mental health findings were based on self-report symptoms and behaviors. They do not represent a clinical diagnosis. Probable PTSD was assessed using a PTSD Checklist (PCL) - Civilian (PCL-C). The highest prevalence of probable PTSD was among members of the Army (10.5 percent), Navy (9.7 percent), and Marine Corps (9.1 percent) compared with the Coast Guard (4.1 percent) and Air Force (3.0 percent) (Meadows et al. 2005). Probable depression was assessed by depressive symptoms from the Pa-

tient Health Questionnaire-9 (PHQ-9). The highest prevalence of probable depression was among members of the Marine Corps (13.5 percent), Army (11.0 percent), and Navy (10.1 percent) compared with the Coast Guard (4.4 percent) and Air Force (4.1 percent) (Meadows et al. 2005). The HRBS report did not state if a service member's PTSD or depression was caused by deployments or not.

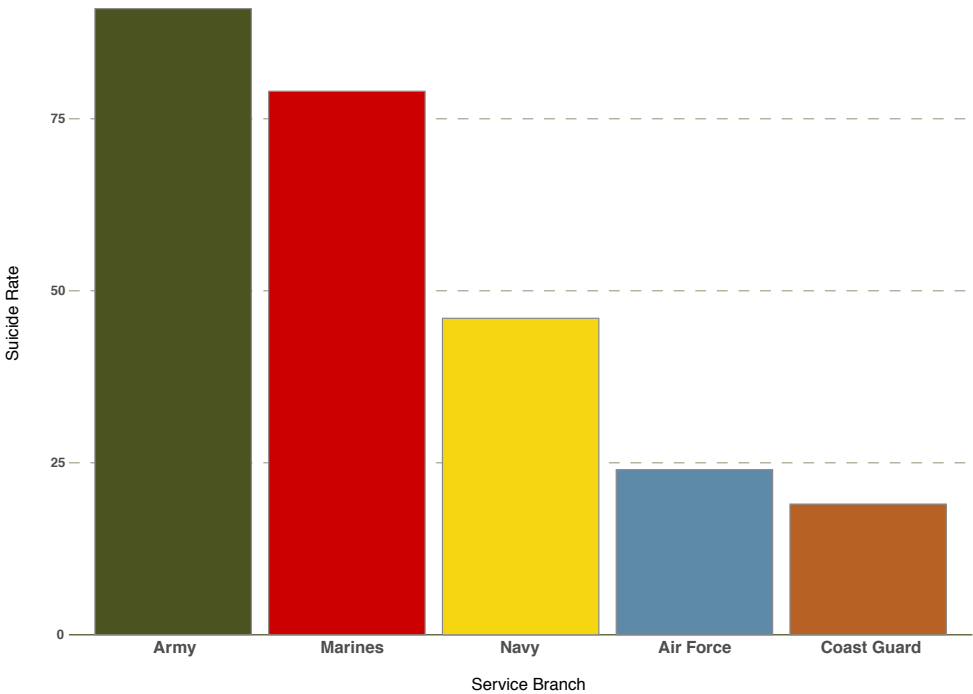
The Demographic variables that were used in the analysis included: Service Branch (Army, Navy, Marines, Air Force, Coast Guard), Pay Grade (Officers, Enlisted), Gender (Male, Female), Age Group (17-24, 25-34, 35-44, 45+), and Married Status (Married, Not Married). These variables were analyzed because they were common suicide factors identified in the literature review. All the variables were labeled as flag variables except the Service Branch and Age Group variables. The military suicide rate for this study was the number of suicide attempts per 1,000 service members.

Figure 1 breaks out the suicide attempts by each service branch. This figure shows that the Army and the Marine Corps has the highest suicide attempts which are consistent with the findings in the literature review about the high suicide rates for the Army and the Marine Corps (Reger et al. 2015).

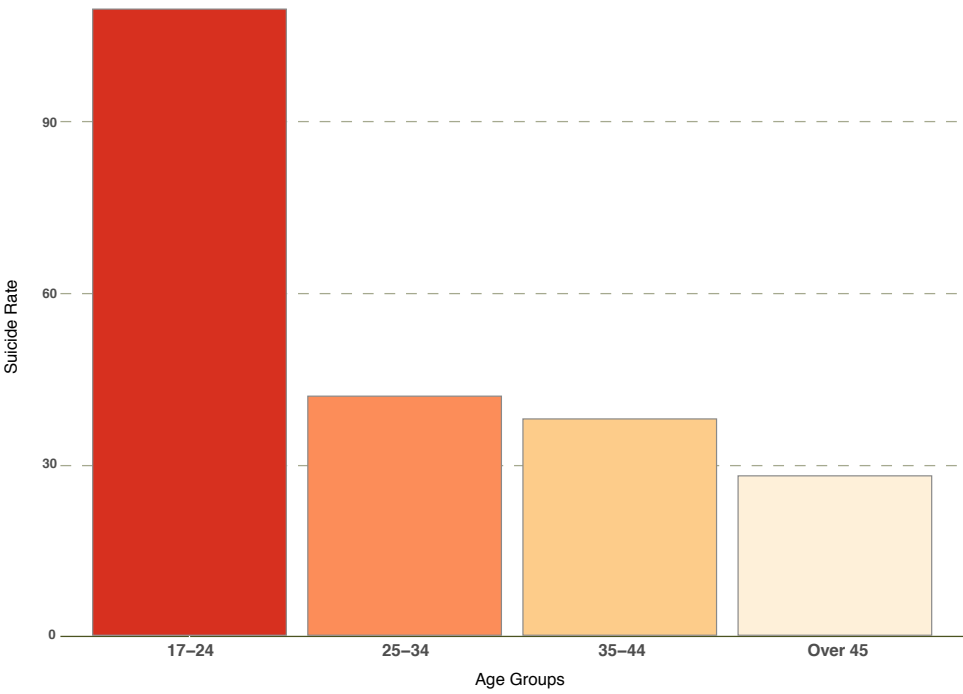
Figure 2 shows that service members who were 17-24 years old had the highest rate of suicide attempts, which is consistent with past studies on military suicides that highlight that younger military personnel are more prone to commit suicide (Reger et al. 2015, Schoenbaum et al. 2014, Yacobi et al. 2013).

The problem variables include finance, drug, and drink. The finance problem variable included responses from the question "Which of the following best describes your financial condition over the past 12 months?". The five response choices were merged into two categories: Yes (in over my head/ tough to make ends meet) and No (very comfortable and secure/ able to make ends meet without much difficulty/ occasionally have some difficulty making ends meet). The drug problem variable included responses from the question if the service member ever misused any

**Figure 1:** Number of Suicide Attempts per 1,000 Service members (Service Branch)



**Figure 2:** Number of Suicide Attempts per 1,000 Service members (Age Groups)



prescription drugs. The drink problem variable included answers from the question if the service member binged on alcohol more than five times the past month. Binge drinking was defined as drinking 5 or more drinks for men or 4 or more drinks for women.

### 3.3 Analytic Approach

Binomial logistic regression was used to estimate the factors which influence suicide attempts. Logistic regression is commonly used for creating models for rare events like suicide attempts. All the variables described above were included in the logistic regression models. The primary focus of this study was on the mental health variables. The positive response for the dependent variable (suicide attempts) made up only 0.5% of the total dataset. This low percentage makes an accurate prediction of suicide attempts difficult because of a potential small sample bias. To combat this issue, the suicide attempts variable was boosted using the balance node in IBM SPSS Modeler. The balance node increased the positive responses in the data set to create a better distribution of this variable. The dataset was partitioned into training and testing partitions before boosting the data to retain the original proportions to avoid over-balancing the data set.

The following four models were created using binomial logistics regression:

- **Model 1:** Used the demographic variables and the key independent variable: PTSD.
- **Model 2:** Used all the Model 1 variables and included the problem variables.
- **Model 3:** Used the demographic variables and the key independent variable: Depression.
- **Model 4:** Used all the Model 3 variables and included the problem variables.

The problem variables were only included in Model 2 and Model 4 to determine if the problem variables had any effect on the mental health variables and if the problem variables improved the overall model fit.

Data management and statistical analyses were performed using IBM SPSS Modeler software version 18.1.1. Data figures were created using R and Adobe Illustrator.

## 4 Results

Table 1 shows the logistic regression exponentiated coefficients for suicide attempts for all four models. The exponentiated coefficients in a logistics regression represent the odds ratio for the individual variable. The reciprocal of the odds ratio for a single variable is the odds ratio for the other value of the particular variable. For example, service members with no PTSD have an odds ratio of .025. The odds ratio for service members with PTSD has an odds ratio of 40 (1/.025). The original outputs of these models includes odds ratios less than one. The reciprocal of those odds ratios, along with the associated variables, is presented in Table 1 for ease of interpretation.

### 4.1 Model 1 and Model 2 Comparison

The results from Model 1 indicate that service members with PTSD are 40 times more likely to attempt suicide than those who do not have PTSD while controlling for all the demographic variables. The high odds ratio for service members with PTSD to attempt suicides supports the findings from the literature review. All the exponentiated coefficients are statistically significant at the  $p < 0.05$  level except for the Male variable. The overall predicted percentage of Model 1 is 82.4%.

Model 2 includes three additional variables (problem variables). The results reveal service members with PTSD are 41.7 times more likely to attempt suicide than those who do not have PTSD while controlling for all the demographic and problem variables. This odds ratio is slightly higher than the Model 1 ratio indicating that the problem variables do not have a big impact on the PTSD variable. All the exponentiated coefficients are statistically significant at the  $p < 0.05$  level except for the Male variable. The overall predicted percentage of Model 2 is 84.6%.

Controlling for the problem variables does not have a large effect (greater than 0.5 change) to the odds ratio of other independent variables with a few exceptions. The problem variables have a negative impact on the Marine Corps decreasing its odd ratio from 4.8 to 3.3. The problem

**Table 1:** Logistic Regression Exponentiated Coefficients for Suicide Attempts

Variable	Model 1 PTSD (DM)	Model 2 PTSD	Model 3 Depression (DM)	Model 4 Depression
<b>Mental Health</b>				
PTSD	40.000* (0.062)	41.667* (0.064)	-	-
Depression	-	-	26.316* (0.055)	23.810* (0.056)
<b>Demographic: Service Branch</b>				
Army	5.834* (0.061)	5.560* (0.062)	4.714* (0.056)	4.280* (0.057)
Navy	1.987* (0.065)	1.904* (0.067)	1.610* (0.061)	1.537* (0.062)
Marine Corps	4.820* (0.065)	3.331* (0.067)	3.046* (0.062)	2.205* (0.065)
Air Force	1.317* (0.064)	1.165* (0.065)	1.128* (0.061)	1.043* (0.062)
<b>Demographic: Age Group</b>				
Age (17-24)	10.627* (0.087)	12.150* (0.090)	4.281* (0.074)	4.536* (0.075)
Age (25-34)	6.106* (0.082)	5.704* (0.085)	3.170* (0.069)	2.672* (0.070)
Age (35-44)	2.995* (0.082)	3.077* (0.085)	2.318* (0.070)	2.131* (0.071)
<b>Demographic: Other</b>				
Enlisted	4.785* (0.050)	4.348* (0.052)	5.376* (0.050)	4.367* (0.051)
Male	1.072 (0.038)	1.060 (0.040)	0.804* (0.037)	0.746* (0.038)
Not Married	2.456* (0.039)	2.061* (0.040)	3.184* (0.038)	3.030* (0.039)
<b>Problem</b>				
Drink	-	2.755* (0.079)	-	1.488* (0.083)
Drug	-	4.167* (0.076)	-	3.636* (0.073)
Finance	-	1.957* (0.066)	-	2.538* (0.061)
<b>Constant</b>	1.481* (.099)	30.213* (0.157)	1.756* (0.092)	20.130* (0.145)
-2 Log Likelihood	19483.919	18766.549	20448.177	19489.187
Overall Predicted %	82.4%	84.6%	81.7%	84.2%

\*  $p < 0.05$ 

DM = Demographic and Mental Health variables only

variables have a positive effect on the Age (17-24) increasing its odds ratio from 10.6 to 12.2.

The following demographic variables analysis applies to both Model 1 and Model 2. The service members who are in the Army or Marine Corps are more likely to attempt suicide than those who are not in the Army or Marine Corps. The youngest age group (17-24 years old) are more likely to attempt suicide than the older age groups. Enlisted service members are more likely to attempt suicide than those who are officers. Males are more likely to attempt suicide than those who are females. Service members who are not married are more likely to attempt suicide than those who are married.

The following problem variables analysis also applies to both Model 1 and Model 2. The service members with a drinking problem are more likely to attempt suicide than those who do not have a drinking problem. The service members with a drug problem are more likely to attempt suicide than those who do not have a drug problem. The service members with a financial problem are more likely to attempt suicide than those who do not have a financial problem.

The findings from the analysis of the demographic and problem variables for Model 1 and Model 2 are all consistent with the findings of the literature review.

A likelihood ratio test is conducted to compare the fit of Model 1 to the fit of Model 2. This test does this by comparing the -2 Log Likelihood values of the models. If the difference is statistically different, then the less restrictive model (i.e., the model with all the variables) fits the data significantly better than the other model (i.e., the model with some of the variables). The difference is called the distributed chi-squared and degree of freedom is the number of parameters constrained (“FAQ: How are the likelihood ratio, wald, and lagrange multiplier (score) tests different and/or similar?” 2018).

For Model 1 and Model 2, the likelihood ratio test statistic is 717.37 (distributed chi-squared) with three degrees of freedom (df). The distributed chi-squared is statistically significant at the .0001 level (critical chi-squared value =16.27 for df=3). Therefore, the full model (Model 2) is superior to the partial model (Model 1) in overall model fit. Also, the overall predicted percentage

improves by 2.2 percentage points from Model 1 to Model 2.

## **4.2 Model 3 and Model 4 Comparison**

The results from Model 3 reveals that service members with depression are 26.3 times more likely to attempt suicide than those who do not have depression while controlling for all the demographic variables. The high odds ratio for service members with depression to attempt suicides supports the findings from the literature review. All the exponentiated coefficients are statistically significant at the  $p < 0.05$  level. The overall predicted percentage of Model 3 is 81.7%.

Model 4 includes three additional variables (problem variables) than Model 3. The results from Model 4 indicates that service members with depression are 23.8 times more likely to attempt suicide than those who do not have depression while controlling for all the demographic and problem variables. This odds ratio was slightly lower than the Model 3 ratio indicating that the problem variables do not have a major impact on the depression variable. All the exponentiated coefficients are statistically significant at the  $p < 0.05$  level. The overall predicted percentage of Model 4 is 84.2%.

Controlling for the problem variables does not have a large effect (greater than 0.5 change) to the odds ratio for the other independent variables with one exception. The problem variables have an adverse impact on the Marine Corps decreasing its odd ratio from 3.0 to 2.2.

The following demographic variables analysis applies to both Model 3 and Model 4. The service members who were in the Army or Marine Corps are more likely to attempt suicide than those who are not in the Army or Marine Corps. The youngest age group (17-24 years old) are more likely to attempt suicide than the older age groups. Enlisted are more likely to attempt suicide than those who are officers. Females are more likely to attempt suicide than those who are males. Service members who are not married are more likely to attempt suicide than those who are married.

The following problem variables analysis also applies to both Model 3 and Model 4. The



service members with a drinking problem are more likely to attempt suicide than those who do not have a drinking problem. The service members with a drug problem are more likely to attempt suicide than those who do not have a drug problem. The service members with a financial problem are more likely to attempt suicide than those who do not have a financial problem.

For Model 3 and Model 4, the likelihood ratio test statistic is 958.99 (distributed chi-squared) with three degrees of freedom (df). The distributed chi-squared is statistically significant at the .0001 level (critical chi-squared value =16.27 for df=3). Therefore, the full model (Model 4) is superior to the partial model (Model 3) in overall model fit. Also, the overall predicted percentage improves by 2.5 percentage points from Model 3 to Model 4.

The findings from the analysis of the demographic and problem variables for Model 3 and Model 4 are all consistent with the findings from the literature review except for the Male variable. Both Model 3 and Model 4 have females more likely to attempt suicide than those who are males which is contrary to the literature review.

### **4.3 Model 2 and Model 4 Comparison**

The following analysis focuses on Model 2 (PTSD) and Model 4 (Depression) which has a better model fit than Model 1 and Model 3, respectively. The exponentiated coefficients for Model 2 and Model 4 are relatively the same (less than 0.5 change) with a few of exceptions.

Service members with PTSD have a higher likelihood of attempting suicide (41.7 times) than those who do not have PTSD. Service members with depression have a higher likelihood of attempting suicide (23.8 times) than those who do not have depression.

Service members in the Army or Marine Corps have a higher likelihood in attempting suicide (5.6 times, 3.3 times) in Model 2 than in Model 4 (4.3 times, 2.2 times). Service members who are 17-24 years old have a much higher likelihood in attempting suicide (12.2 times) in Model 2 than in Model 4 (4.5 times). Service members who are 25-34 years old have a higher likelihood of attempting suicide (5.7 times) in Model 2 than in Model 4 (2.7 times). Service members who

are 35-44 years old have a higher likelihood of attempting suicide (3.1 times) in Model 2 than in Model 4 (2.1 times).

Service members who are not married have a lower likelihood in attempting suicide (2.1 times) in Model 2 than in Model 4 (3.0 times). Service members who have a drinking problem have a higher likelihood of attempting suicide (2.8 times) in Model 2 than in Model 4 (1.5 times). Service members who have a financial problem have a lower likelihood in attempting suicide (1.96 times) in Model 2 than in Model 4 (2.5 times). In Model 2 and Model 4, the Air Force and Male variables have exponentiated coefficients close to 1 (less than 0.5 difference). Exponentiated coefficients that are close to 1 indicates that these variables do not have an impact on determining the likelihood of suicide attempts.

Male was the only variable that changed likelihood tendencies from Model 2 to Model 4. In Model 2, service members who are males have a small likelihood in attempting suicide (1.1 times). In Model 4, service members who are females have a low likelihood of attempting suicide (1.3 times). The likelihood tendency changing in the Male variable is not relevant because the exponentiated coefficient in Model 2 is not statistically significant at the  $p < 0.05$  level and both exponentiated coefficients are close to 1.

In summary, the following variables in Model 2 have a higher likelihood of suicide attempts than Model 4: Army, Marine Corps, Age (17-24), Age (25-34), Age (35-44), Drink Problem. The following variables in Model 4 have a higher likelihood of suicide attempts than Model 2: Not Married, Finance Problem. In both models, the Air Force and Male variables do not have an impact on determining the likelihood of suicide attempts.

#### **4.4 Key Findings**

Service members with PTSD or depression have a high likelihood of attempting suicide controlling for common suicide factors. Service members with PTSD are 41.7 times more likely to attempt suicide than those who do not have PTSD. Service members with depression are 23.8 times

more likely to attempt suicide than those who do not have depression. These findings seem to be consistent with literature review finding of PTSD and depression related to combat exposure from deployments heightened suicide risk (Schoenbaum et al. 2014; Harrell and Berglass 2011; Bryan and Cukrowicz 2011; Yacobi et al. 2013). As stated earlier, the HRBS report does not indicate if the service member's PTSD or depression was a direct result of deployments.

In all the models, service members have a high likelihood (above 3.0 times) in attempting suicide if they have one of the following characteristics: Army, 17-24 years old, Enlisted, Drug Problem. While the gender of the service member and being in the Air Force does not have an impact on determining the likelihood of a service member attempting suicide.

Controlling for the problem variables in both the PTSD and depression models does not affect (less than .005 change in odds ratio) on the mental health variables and has a minor effect (less than 2.0 change in odds ratio) on the other independent variables.

## **5 Conclusion**

The results from this report confirm the hypothesis that service members with PTSD or depression will have a higher likelihood of attempting suicide controlling for common suicide factors. Service members with PTSD are 41.7 times more likely to attempt suicide than those who do not have PTSD. Service members with depression are 23.8 times more likely to attempt suicide than those who do not have depression. The suicide factors that produced a high likelihood in a service member attempting suicide (over three times) in all the models include Army, 17-24 years old, Enlisted, and Drug Problem. These factors are consistent with the findings from the literature review.

## **5.1 Study Strengths and Limitations**

The strength of this study is that the 2015 HRBS survey data that is analyzed is more recent compared to the other studies in the literature review. Also, the HRBS data is comprehensive including variables that included areas such as mental and physical health along with health-related behaviors like suicide attempts.

A number of limitations should be noted in this study. The HRBS survey data is public use only, which means data from the original HRBS survey dataset was removed such as specific demographic data (e.g., race, education, and specific pay grades) and deployment data (e.g., number of deployments, combat exposure). Due to the lack of accessible deployment data, relationships with deployment and mental health could not be analyzed. The HRBS survey data also did not include all the suicide factors that are identified in the literature review, specifically military relationship problems and intimate personal problems. The participants of this HRBS survey are only active U.S. military service members and did not include those who separated from the U.S. military. Lastly, it is unclear how much selection bias influenced these data due to the low response rate of the 2015 HRBS survey. Only 16,699 service members completed the survey, which makes up only 0.01% of the total eligible population.

## **5.2 Recommendations**

Suicide prevention programs in the U.S. military are under constant pressure to decrease the military suicide rates and effectively use their funding. To address these issues, suicide prevention programs should identify and target groups at high risk. Based on the results from this study, suicide prevention programs should target service members with PTSD or depression. Also, these programs should focus on service members who are in the Army, 17-24 years old, enlisted or have a drug problem.

Future analysis is needed to control for other variables, not included in this study, that may

influence the complicated relationship between service members and suicides. These variables include, but are not limited to: relationship problems, deployment data, specific pay grades, race, and education. Also, future datasets should also include U.S. military veterans.

In the last decade, the suicide rate among the active-duty U.S. military has increased significantly and become the leading cause of death for U.S. military service members (Reger et al. 2015; VanSickle et al. 2016). Suicides in the military is an important issue not only for those in the military but the family members of the military. These family members are fully invested in making sure the military takes the necessary actions to prevent these military suicide rates from increasing. The U.S. military should invest in more comprehensive studies on military suicides and ensure suicide prevention programs are targeting groups at high risk identified in these studies.

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## **7 Curriculum Vita**

Philip Lee is currently a degree candidate with the Johns Hopkins University working towards a Master of Science in Government Analytics. He graduated from the Cornell University in 2001 with a Bachelor of Science in Operations Research and Industrial Engineering. He served four years of dedicated military service as a U.S. Naval Officer. Philip is an experienced and proven information technology analyst in the Department of the Navy who worked over ten years as both a civil servant and management consultant. He possesses a wealth of knowledge and experience in the fields of open data, crowdsourcing, innovation, information management, information technology, and information sharing. He is a certified Project Management Professional (PMP).